

## **II. HAZARD VULNERABILITY**

### **A. INTRODUCTION**

What is vulnerability? Vulnerability is the susceptibility of resources to negative impacts from hazard events. Risks result from a combination of a natural hazard and a vulnerable population. For hazards to be properly mitigated, risk must be properly characterized and understood. Characterization is a determination of what the hazard is, where the hazard occurs, how severe it is, and how often it may occur.

It is these negative impacts of characterization that concern most people. While the study of hazards, risks, and probabilities is an important component of vulnerability, alone it does not provide resource managers with the information necessary to prioritize mitigation alternatives or measure improvements in mitigation. In order to make efficient use of your mitigation resources, it is not enough to know if, when, or even where a hazard event will strike. You need to know where your vulnerabilities are so you can make the most of your pre-disaster planning efforts.

Mitigation opportunities exist when mitigation requirements can be met in conjunction with other community goals or projects. In pursuit of "disaster resistant communities, emergency program managers and other community leaders are constantly recognizing needs and opportunities for mitigation actions.

For each hazard, the state is examined for risk related factors. These factors are the characteristics that influence how the hazard will affect the State. These factors include geographic features, geologic features, soil composition, infrastructure lifelines, population densities and availability of response resources.

### **B. STATE DESCRIPTION**

Before an in depth analysis of the hazards, which potentially impact the State of Montana, it would be beneficial to review the general character of the State and its people.

Montana is the fourth largest state in the nation, exceeded in size by only Alaska, Texas, and California. The state's east-west dimension averages 500 miles while the distance north to south averages 275 miles. Montana covers 147,138 square miles (94,168,000 acres), approximately 1,600 square miles (900,000 acres) of which is surface water. The 2000 census pegged Montana's population at 902,195 supported by one U. S. Representative. Since 1992, the population has increased. However, Montana's population is still significantly below 1 million. The State of Montana is divided into three geographic regions: The plains of Eastern Montana cut by the Missouri, Yellowstone, Powder and Tongue Rivers, the foothill-interrupted plains in the center of the state, and the mountainous regions of the West.

The physical characteristics of the state contribute to its diverse climate. Other factors that determine the state's climate include altitude, the inland position of the state on the continent, and the movement of air masses and storms from various locations. Occasionally during the winter, a cold, dry air mass may build up which dominates Eastern Montana and sometimes the entire state. Blizzards, strong winds, blowing snow, and poor visibility may occur in conjunction with the onset of a cold wave.

Summer weather patterns cause a flow of unstable air into the state, resulting in several types of severe storms. The most troublesome of these storms are high-intensity rains with hailstorms, which cause flash floods, crop and property damage. Lightning occurs with all thunderstorms. A typical Montana thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Often thunderstorms produce little rain, but generate very strong wind gusts and dust storms. East of the divide, intense straight-line winds (windstorms) can occur several times a year.

Tornadoes also occur infrequently (five per year reported) in the eastern third of the state during May through August. On August 14, 1999, a tornado hit the center of Lewistown, Montana (population 6,051) at approximately 8:14 p.m. This tornado caused significant damage. 500 homes, 250 mobile homes and several downtown business sustained damage, including the City Government complex which houses the emergency response services and the 911 dispatch. . One person was reported injured. The American Red Cross established a temporary shelter. Tornadoes have resulted in no reported deaths in Montana.

Montana precipitation ranges from just over six inches in the south central part of the state to nearly 120 inches in the northwest. More than one-half of the state receives less than or equal to 14 inches of annual precipitation. Except for the western mountainous regions, Montana is a dry state, and as such, precipitation tends to be highly variable. Dry periods or wet periods lasting for a number of months and, at times, for several years are not uncommon in this state.

Montana temperatures also vary widely; maximum temperatures exceeding 100 degrees have occurred at most recording stations in the state, and temperatures ranging well below zero occur almost every winter. The greatest temperature extremes occur east of the divide.

Water is an important resource in Montana; it plays an essential role in agriculture, industry, power production, the home and recreation. Since most surface water in the state originates as precipitation, Montana need not rely primarily upon inflow from other areas. Seasonal and annual dependability of stream flow is largely determined by runoff. Nearly half the state discharges less than one inch per year, however, mountainous areas along the Continental Divide discharge a high amount of runoff. The snow pack begins to melt in April and usually reaches a peak in late May or early June. Snow and channel ice that accumulate in eastern plains

streams normally melt in late March or early April and may produce the peak flow of the year.

Montana contains over 1,500 natural lakes, located primarily in the mountainous areas of western and south central Montana. There are over 3500 dams and reservoirs in the state. One hundred-twenty of these dams are classified as high hazard, which means, if the dam fails people will die. Many of these reservoirs were constructed as single purpose projects for either stock-water storage or irrigation. Their value has increased over the years through being used for incidental flood control, fish and wildlife, and recreational benefits.

The quality of Montana's surface waters is generally rated from good to excellent. Principal exceptions include local bacterial contamination below municipal discharges, chemical and toxicity problems below mining and petroleum operations, and suspended sediment from periods of high stream runoff, geologic erosion, and improper land use activities.

Surface water serves primarily people who live in the cities and larger towns, while smaller towns rely almost exclusively on ground water for domestic consumption. Ground water in western Montana is of higher quality than that found in eastern Montana.

The geography of the state is reflected in some population settlement patterns as shown in Figure 1. Areas of low-density settlement usually represent regions of severe limitations imposed by terrain or moisture availability. Slightly more than 50 percent of the state's population resides in seven western counties: Yellowstone, Cascade, Missoula, Silver Bow, Flathead, Lewis and Clark and Gallatin (Taylor et al, 1974).

The population of an area directly affects its degree of vulnerability to any hazard. Densely populated areas that coincide with high-risk hazard locations are considered highly vulnerable to the hazards involved while the same locations if sparsely populated are considered less vulnerable. Protection of life and property remains the core duty of Disaster and Emergency Services.

# State of Montana Natural Hazards Mitigation Plan – November 2001

Census 2000 Public Law 94-171 File  
Total Population, Population Density, and Land Area for Montana Counties

	TOTAL POPULATION	POPULATION DENSITY*	LAND AREA SQ. MILES
Montana	902,195	6.20	145,552.45
Beaverhead County	9,202	1.66	5542.31
Big Horn County	12,671	2.54	4994.81
Blaine County	7,009	1.66	4226.18
Broadwater County	4,385	3.68	1191.35
Carbon County	9,552	4.66	2047.99
Carter County	1,360	0.41	3339.57
Cascade County	80,357	29.79	2697.90
Chouteau County	5,970	1.50	3973.24
Custer County	11,696	3.09	3783.13
Daniels County	2,017	1.41	1426.09
Dawson County	9,059	3.82	2373.14
Deer Lodge County	9,417	12.78	736.98
Fallon County	2,837	1.75	1620.33
Fergus County	11,893	2.74	4339.17
Flathead County	74,471	14.61	5098.34
Gallatin County	67,831	26.03	2605.84
Garfield County	1,279	0.27	4668.06
Glacier County	13,247	4.42	2994.72
Golden Valley County	1,042	0.89	1175.30
Granite County	2,830	1.64	1727.44
Hill County	16,673	5.76	2896.36
Jefferson County	10,049	6.07	1656.64
Judith Basin County	2,329	1.25	1869.85
Lake County	26,507	17.75	1493.77
Lewis and Clark County	55,716	16.10	3460.96
Liberty County	2,158	1.51	1429.76
Lincoln County	18,837	5.21	3612.67
McCone County	1,977	0.75	2642.53
Madison County	6,851	1.91	3586.54
Meagher County	1,932	0.81	2391.82
Mineral County	3,884	3.18	1219.82
Missoula County	95,802	36.88	2597.97
Musselshell County	4,497	2.41	1867.15
Park County++	15,694	5.60	2802.41
Petroleum County	493	0.30	1653.90
Phillips County	4,601	0.90	5139.57
Pondera County	6,424	3.95	1624.70
Powder River County	1,858	0.56	3297.18
Powell County	7,180	3.09	2325.94
Prairie County	1,199	0.69	1736.55
Ravalli County	36,070	15.07	2394.21
Richland County	9,667	4.64	2094.09
Roosevelt County	10,620	4.51	2355.60
Rosebud County	9,383	1.87	5012.37
Sanders County	10,227	3.70	2762.17
Sheridan County	4,105	2.45	1676.58
Silver Bow County	34,606	48.18	718.31
Stillwater County	8,195	4.57	1795.09
Sweet Grass County	3,609	1.95	1855.08
Teton County	6,445	2.84	2272.61
Toole County	5,267	2.76	1910.95
Treasure County	861	0.88	978.86
Valley County	7,675	1.56	4921.00
Wheatland County	2,259	1.59	1423.09
Wibaux County	1,068	1.20	889.31
Yellowstone County	129,352	49.09	2635.15

\* Population density equals total persons divided by land area in square miles.

Source: U.S. Census Bureau, Released March 21, 2001

Compiled by: Census and Economic Information Center, Montana Dept. of Commerce (406) 444-2896

**MONTANA INDIAN RESERVATION  
DECENNIAL CENSUS TOTAL RESIDENT POPULATION  
1990-2000**

<b>RESERVATION</b>	<b>2000 CENSUS</b>	<b>1990 CENSUS</b>	<b>NUMERIC CHANGE</b>	<b>PERCENT CHANGE</b>
Blackfeet and off - Reservation Trust Land	10,100	8,549	1,551	18%
Crow and off -Reservation Trust Land	6,894	6,370	524	8%
Flathead	26,172	21,259	4,913	23%
Fort Belknap and off - Reservation Trust Land	2,959	2,508	451	18%
Fort Peck and off - Reservation Trust Land	10,321	10,595	(274)	-3%
Northern Cheyenne and off - Reservation Trust Land	4,470	3,923	547	14%
Rocky Boy and off - Reservation Trust Land	2,676		2,676	37%
Turtle Mountain and Off- Reservation Trust Land, MT- ND-SD*	24		24	

Notes: Off reservation trust lands, along with reservation lands, constitute the territory over which American Indian Tribes have primary governmental authority. Trust land is property associated with a specific American Indian reservation or tribe, held in trust by the federal government. Trust lands recognized in data tabulations are always "off reservation"; that is, they comprise all tribal and individual trust lands located outside of a reservation boundary. (For information that is more detailed see Appendix A in the Public Law 94-171 for Technical Documentation.

\* The Montana portion of the Turtle Mountain Reservation and Off-Reservation Trust Land is Trust Land spread over thirteen counties.

## State of Montana Natural Hazards Mitigation Plan – November 2001

<b>QUICKFACTS</b>	
<b>People Quick Facts</b>	<b>Montana</b>
Resident Population, 2000 Census	902,195
Resident Population, 1990 Census	799,065
Population percent change, 1990-2000	12.9%
White population, 2000	90.6%
Native American (American Indian/Alaska Native), 2000	6.2%
Asian, 2000	0.5%
Black/African American, 2000	0.3%
Native Hawaiian/Other Pacific Islander, 2000	0.1%
Some other race, 2000	0.6%
Hispanic or Latino population, 2000	2.0%
Population age 18 years and over, 2000	74.5%
Population under 18 years old, 2000	25.5%
Population 65 years old and over, 1999 estimate	13.3%
Median Age, 1999 estimate	37
Male population, 1999 estimate	438,758
Female population, 1999 estimate	444,021
High school graduates, persons 25 years and over, 1999	88.8%
College graduates, persons 25 years and over, 1999	24.0%
Homeownership rate, 2000 estimate	70.2
Total housing units, 1998 estimate	382,881
Single family homes, 1990	245,965
Total households, 1998 estimate	346,070
Persons per households, 1998 estimate	2.47
Family households, 1990	213,625
Persons below poverty, percent, 1997-99 three year average	15.9%
Children under age 18 below poverty, percent, 1997 estimate	21.3%
<b>Economic Quick Facts</b>	<b>Montana</b>
Total personal income, 2000(p) (\$1000)	\$20,362,085
Per capita personal income, 2000(p)	\$22,569
Median household income, 1997-99 three year average	\$31,280
Average wage per job, 1999	\$23,037
Median family income, 1998 four person family	\$44,737

### **C. PURPOSE OF THE ANALYSIS**

Emergency management has evolved from the single focus civil defense concern of the 1950's and 1960's to the present comprehensive, all-hazards approach by government at the local, state and federal levels.

In the last decade, the Federal Emergency Management Agency (FEMA) implemented an Integrated Emergency Management System (IEMS), which emphasizes the all-hazards approach in the mitigation, preparedness, response, and recovery phases of emergency management. Effective emergency management, therefore, requires the identification and analysis of all hazards, which potentially affect a jurisdiction. The first step in the IEMS process is the preparation of a hazard and vulnerability analysis. The purpose of the analysis that follows is fourfold:

- 1) To communicate the importance and uses of a hazard and vulnerability analysis;
- 2) To increase awareness of potential hazards affecting the State of Montana;
- 3) To increase awareness of state vulnerability to those hazards; and
- 4) To communicate the importance of hazard mitigation.

Three objectives have been identified to fulfill the above-stated purpose:

- 1) Identify and analyze potential natural and man-caused hazards affecting Montana.
- 2) Assess state vulnerability to those hazards.
- 3) Suggest mitigation strategies.

### **D. ANALYSIS OVERVIEW**

During the 31-year period from 1975 to 2001 the Governor of Montana declared fifty-three state disasters. Montana also received nine Presidential Disaster Declarations in this same period. These disasters have resulted in the expenditure of millions of dollars for damage repair.

This document will identify and discuss potential major hazards that might affect the state, and the existing degree of vulnerability to those hazards. The information provided by this analysis will enable emergency management personnel to set priorities and goals for resource allocation and preparedness activities which will in turn enhance the capability to respond in the event of a disaster.

This report is the result of a comprehensive study of the types of disasters that have occurred in Montana as well as potential hazards that threaten the state. The information presented was drawn from literature review, studies conducted by Montana State University and University of Montana students and professors, communication with Montana State government personnel from various departments, and contacts with numerous private organizations.

**The following six hazards, wildfire, winter storm, flood, volcanic eruption, earthquake, and drought are included in this plan.** Other annexes such as Landslide, Avalanche, and Nuclear Attack can be found in Montana's "Hazard Vulnerability Analysis"

**Within each of the following sections there are seven subsections: Hazard Description, Historical Occurrence and Response, Prediction Potential for Recurrence, State Vulnerability to the Hazard, Mitigation, Summary, and Recommendations.** A final section will summarize the discussion. Subsections have been delineated so that users may easily access specific information without reading text irrelevant to their needs. References used in researching each hazard will be listed in the respective section.

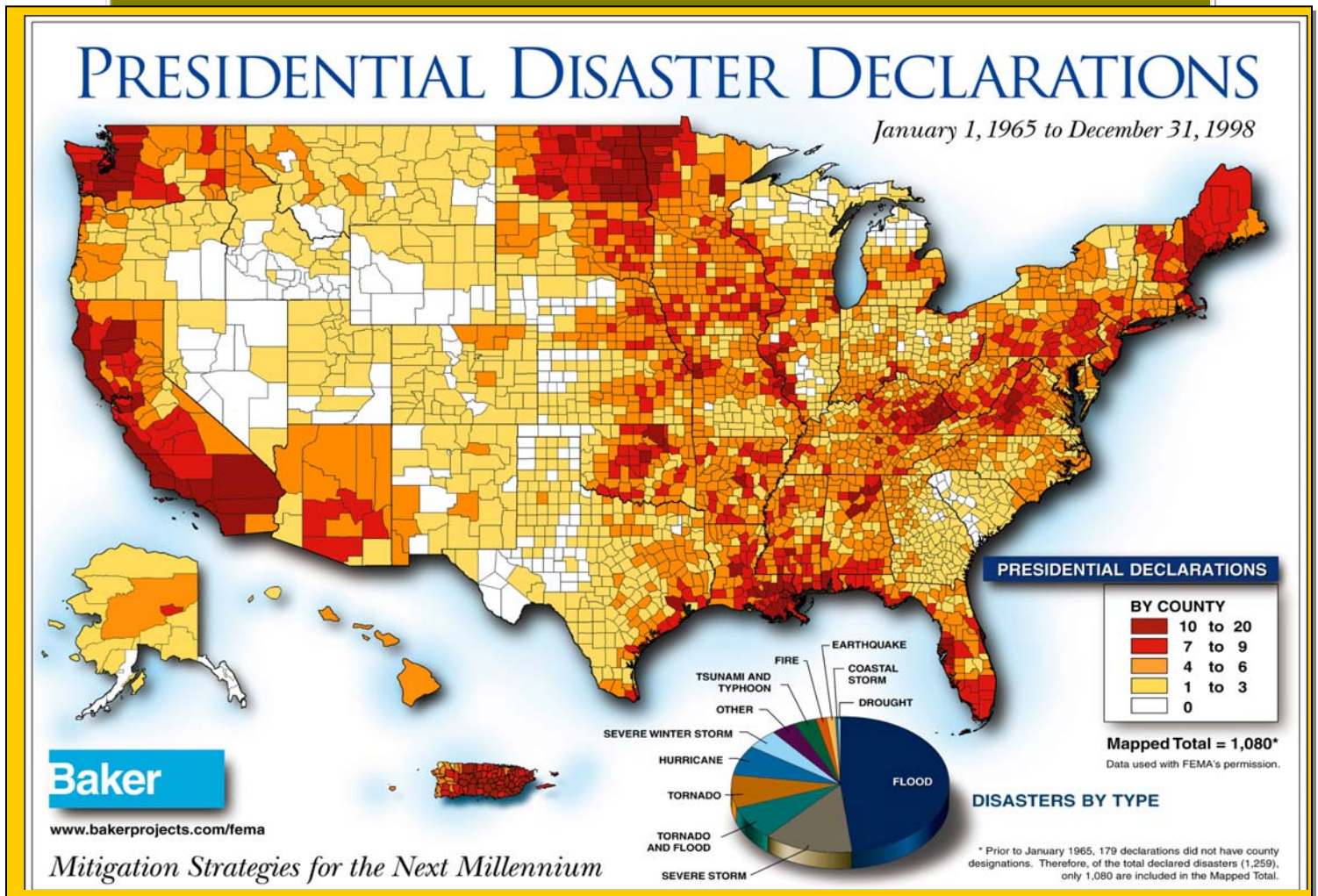
STATE OF MONTANA					
MAJOR Disasters (DR) & Emergency Declarations (EM)					
January 1, 1996 to July1, 2001					
Date Declared	Event Type	FEMA Disaster Declaration #	Program(s)	Dollar Amount	Counties Declared
2/23/96	Severe Storm Flooding	FEMA-1105-DR	PA	\$2,000,003	Lincoln, Sanders, Mineral, Missoula, Powell, Deer Lodge, Silver Bow, Ravalli, Jefferson, Lewis & Clark, Chouteau, Meagher, Gallatin, Park
5/16/96	Severe Storm, Flooding, Ice jams	FEMA-1113-DR	PA	\$1,668,000	Flathead, Toole, Liberty, Hill, Blaine, Phillips
10/01/97	FLOOD	FEMA-1183-DR	PA	\$6,306,000	Chouteau, Deer Lodge, Gallatin, Jefferson, Lewis & Clark, Lincoln, Meagher, Mineral, Missoula, Park, Powell, Sanders, and Silver Bow
	WILDLAND FIRE	FEMA-1340-DR	PA/IA	\$13,859,000	Forty-eight of the fifty-six counties and six Indian reservations
	WINTER STORM	FEMA-1350-DR	PA	\$2,300,000	Carter, Fallon, Richland, Roosevelt, Sheridan, and Wibaux
	WINTER STORM	FEMA-1377-DR	PA	\$1,000,000	Bighorn County and Crow Indian Reservation
	WINTER STORM	FEMA-1385-DR	PA	Still computing	Gallatin, Missoula, Powell
10 Declarations Totaling					



STATE OF MONTANA					
MAJOR Disasters (DR) & Emergency Declarations (EM)					
January 1, 1996 to July1, 2001					
Date Declared	Event Type	FEMA Disaster Declaration #	Program(s)	Dollar Amount of HMGP	Counties Declared
2/23/96	Severe Storm Flooding	FEMA-1105-DR	PA & MIT	\$231,990	Lincoln, Sanders, Mineral, Missoula, Powell, Deer Lodge, Silver Bow, Ravalli, Jefferson, Lewis & Clark, Chouteau, Meagher, Gallatin, Park
5/16/96	FLOOD	FEMA-1113-DR	PA & MIT	\$207,000	Flathead, Toole, Liberty, Hill, Blaine, Phillips
8/23/97	FLOOD	FEMA-1183-DR	PA & MIT	\$763,425	STATEWIDE
8/30/2000	WILDLAND FIRE	FEMA-1340-DR	PA, IA, MIT	\$169, 530	STATEWIDE
12/6/2000	WINTER STORM	FEMA-1350-DR	PA & MIT	\$318,375	STATEWIDE
5/28/01	WINTER STORM	FEMA-1377-DR	PA & MIT	\$113,498	STATEWIDE
7/7/01	WINTER STORM	FEMA-1385-DR	PA & MIT	\$135,065	STATEWIDE
10 Declarations Totaling					

## Presidential Disaster Declarations by State

For the period of 1975 – 1998



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